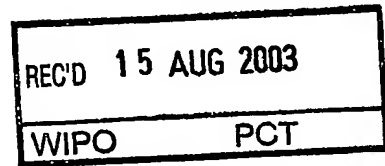


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## CERTIFICATE

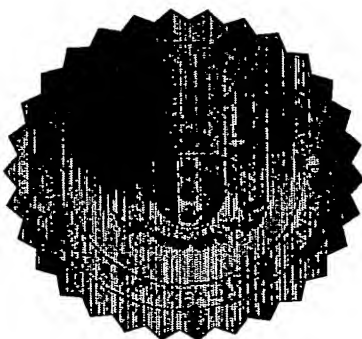
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I hereby certify that annexed is a true copy of the Provisional Specification as filed on 4 July 2002 with an application for Letters Patent number 519996 made by TAIT ELECTRONICS LIMITED.

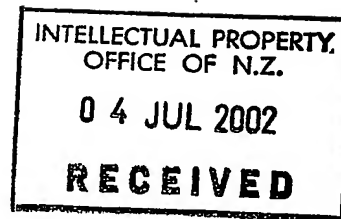
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## **PROVISIONAL SPECIFICATION**

**Group calls in a mobile radio system**

We **TAIT ELECTRONICS LIMITED**, a New Zealand company of 558 Wairakei Road, Burnside, Christchurch, do hereby declare this invention to be described in the following statement:

## GROUP CALLS IN A MOBILE RADIO SYSTEM

### FIELD OF THE INVENTION

This invention relates to calling patterns in mobile radio systems, particularly but not only  
5 to wide area group calls in packet switched data networks.

### BACKGROUND TO THE INVENTION

A common calling pattern in mobile radio systems is a wide area group call in which  
multiple mobile users served by multiple sites can all converse. These calls may be  
10 implemented in trunked, simulcast and voted conventional networks. Base stations  
provide an air interface for the users. When a user speaks they are heard by all other  
group members on all sites participating in the group.

Sometimes two users at different sites speak at the same time. In analogue  
conventional and simulcast networks a centralised voter is commonly used to arbitrate or  
15 choose one signal to be broadcast by the base stations. Trunked networks often use a  
centralised conference bridge to mix the audio received from all of the participating sites.  
Circuit switched telephony also generally uses a centralised conference bridge. Packet  
voice systems typically use a range of approaches for conference calls including a  
centralised multi point controller.

20 Conventional systems have various drawbacks. There is a reduced choice of  
speech paths and calls must be sent through a voter, bridge, controller or other centralised  
component, even if the base stations serving the users are close together. This component  
can be a common point of failure. These systems are not fully scalable and the central  
component usually accommodates only a fixed number of base stations. It may be  
25 unnecessarily expensive in both small and large networks, and is simply another  
component in the overall structure of a network.

### SUMMARY OF THE INVENTION

It is an object of the invention to provide an improved method of arbitrating group calls in  
30 a digital mobile radio system, or at least to provide an alternative to existing methods. In

general terms the base stations that are serving mobile units in a call each announce the nature of the signals that they are receiving. The stations then each compare the signals and decide which signal will be broadcast to the mobile units, without need of a central component. The signals are preferably transmitted between base stations via a packet network using IP multicast.

In one aspect the invention may be said to consist in a method of operating a packet network having base stations for communication with mobile units, comprising: initiating a call involving a group of mobile units, receiving a signal at two or more of the base stations from one of the units, determining a respective priority parameter the signal received at each base station, adding the priority parameters to at least some packets of the respective signals, transmitting the signals containing the priority parameters to the network, receiving the signals at base stations for transmission to mobile units in the group, and transmitting the signal having a selected priority parameter to the unit

Preferably the method includes ceasing transmission to the network, of a signal received from the mobile unit, after determining that the signal has a priority lower than that of a corresponding signal received from the network. Also commencing transmission of a signal to the network, received from the mobile unit, after determining that the signal has a priority greater than that of a corresponding signal received from the network.

Preferably the priority parameter is determined by quality of the respective signal received from the mobile, and the signal transmitted to the units is selected according to highest quality. Alternatively the priority parameter may be determined by a priority allocated to the calling unit. The priority parameter of a signal is generally set to a termination value when the signal ends. The priority parameter may or may not be sent in a voice packet, and could be sent in a special voting or quality packet, or included in a packet that contains other signalling data.

In a further aspect the invention consists in a method of operating a packet network having base stations for communication with mobile units, comprising: initiating a call involving a group of mobile units, receiving signals at two or more of the base stations from two or more of the units, determining a respective priority parameter for each of the signals received at a base station, adding the priority parameters to at least

some packets of the respective signals, transmitting the signals containing the priority parameters to the network, receiving the signals at base stations for transmission to mobile units in the group, and transmitting the signal having a selected priority parameter to the units.

5        Preferably the method further comprises ceasing transmission to the network, of each signal received from a mobile unit, that has a priority lower than that of a corresponding signal received from the network.

In a further aspect the invention consists in a communication network or a base station for a network that implements or assists in a method as set out above.

10        The invention also consists in any alternative combination of features that are shown or indicated in the specification. All equivalents of these features are included whether or not expressly set out.

## LIST OF FIGURES

15        Preferred embodiments of the invention will be described with respect to the drawings, of which:

Figure 1 shows a mobile radio system having a core network, base stations and mobile units,

20        Figures 2-7 are a sequence showing the user of a mobile unit in Figure 1 talking in a group call,

)        Figures 8-10 are a sequence showing users of two mobile units attempting to talk in a group call,

Figure 11 shows detail of typical messages transmitted between the mobile units and the base stations in relation to Figures 2-10,

25        Figures 12-15 summarise the states and transitions between states of a base station in Figures 2-11.

## DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the drawings it will be appreciated that group calls according to the invention  
30        may be implemented in many ways in a range of networks. Details of the mobile units,

base stations and networks will be understood by a skilled reader and have not been included.

Figure 1 schematically shows a mobile radio system having a core network and five base stations A-E serving mobile units. The core network is a packet network using the Internet Protocol, for example, that may be connected in various ways. Each base station generally has an irregular area of RF service that may overlap with the service areas of other stations. The units may be within range of several base stations at once but are generally captured by one or other station according to the quality or other aspects of their respective signals. The units may participate in group calls using IP multicast techniques within the core network. Packets from a talker unit are distributed between base stations in the network and broadcast to other units in the group.

Signals received at base stations involved in a group call are of varying quality depending on how close the transmitting mobile or mobiles are to the stations. The signals may be given priority in accord with their quality, or with another parameter such as status of the mobile user, in order to determine how they will be broadcast to the group. Quality is usually measured in terms of received or residual bit error rate. Base stations transmitting voice packets to a multicast address in the core network attach a quality metric or similar parameter to at least some of the packets that they send. Stations receiving RF signals from mobile units compare the quality metrics in signals from the network with those in signals from the RF links. The comparison by each station is used to determine whether to start, continue or cease sending to the multicast.

Figure 2 shows the user of a mobile unit within range of two base stations A and B, starting to talk to a group of units. The RF signal at station A has higher quality than the signal at station B. Initially both stations send their received signal to the multicast address in the core network and both include respective quality metrics in at least some of the packets they send. Stations C, D, E receive both signals and determine that the quality of A is greater than that of B, and therefore that the signal received from A should be transmitted on the RF link to other units in the group. Station B also receives the signal from station A and transmits that signal locally to other mobiles, rather than the signal it has received itself from the talker unit. Station A receives the signal from station B and

transmits the signal received directly from the talker unit, rather than the signal from station A.

5 In Figure 3, base station B determines that the signal received from station A has higher quality than the signal received locally from the talker unit, and ceases to send the local signal to the network. Stations C, D, E receive and broadcast only the signal from station A. The signal from station A may or may not continue to include a quality metric or other priority parameter.

10 In Figure 4 the talker unit has moved closer to station B so that the signal received at station B has higher quality than that of station A. However, station A has not yet transmitted a new quality indicator so transmission to the network by station A continues, and station B remains silent in relation to this particular call. Stations B, C, D, E continue to broadcast the signal from station A.

15 In Figure 5 station A now sends a quality indicator in the signal to the network. An indicator might be sent at regular intervals or according to actual quality of the signal for example. Station B compares the quality indicator to the quality of the signal that is received locally from the talker unit. Station B determines that the local quality is higher than that of the signal from station A and starts sending the locally received signal to the network.

20 In Figure 6 all base stations have received the multicast signal from stations A and B. Each determines that the signal from B has higher quality than the signal from station A and broadcast the signal from station B to units in the group call. Station A ceases transmission of its locally received signal, and transmits the signal from B to both the network and the local units involved in the call.

25 In Figure 7 the user of the talker unit stops speaking and station B indicates this to the rest of the network. For example, a signal having the lowest possible quality or a null parameter is sent as the signal is terminated.

30 Figure 8 shows the users of two mobile units in a group call starting to talk at the same time. Talker unit X is within range of base stations D and E. Talker unit Y is within range of base stations E and A. At station E, unit X has a stronger or better quality signal than unit Y and unit X takes precedence by a capture effect. Stations D, E and A all send

their signals locally received from units X or Y to the network. Each adds a quality metric to the signal.

5 In Figure 9 all base stations are receiving the signals from stations D, E, A through the network, including a quality metric. However, the signal from station D for unit X has the highest quality and only that signal is broadcast to the other units in the call. A session continuity mechanism ensures that the signal from unit X continues uninterrupted by signals from other units at which a user attempts to talk and that may have higher quality than that from unit X.

10 In Figure 10 stations E and A have received the quality indicator in the signal from station D and cease transmission of their locally received signals. All stations now broadcast the signal received from unit X by station D.

Figures 11-15 set out further details of the process described above and are generally self explanatory.

#### 15 *Sending a Quality Metric*

Traffic channels that are receiving data over the air interface may transmit packets to the multicast address assigned to the group call. They will generally send packets to the multicast with a quality metric in the following situations:

- 20 • They receive a packet from the network with a quality indicator that is worse than the quality of data they are currently receiving on the air interface.
- There is a pause in the conversation, they are not receiving any packets from the network but they start receiving data on the air interface.
- They are currently sending packets to the network but the quality of the data received on the air interface degrades significantly. This will prompt a base station with a  
25 better signal to start sending to the multicast.
- They are currently sending packets to the network but they stop receiving data on the air interface. This may indicate a pause in the conversation.
- They are currently sending packets to the network but they have not sent a quality  
30 indicator for some time out, 5 seconds for example. It may be desirable to send a quality metric with every voice packet.

The traffic channel currently sending packets to the network controls re-voting by sending the quality metric.

The quality metric may or may not be carried on a packet that includes voice data.

5 The packet may be a special voting or quality packet or a packet that carries other signalling data.

### *Receiving a Quality Indicator*

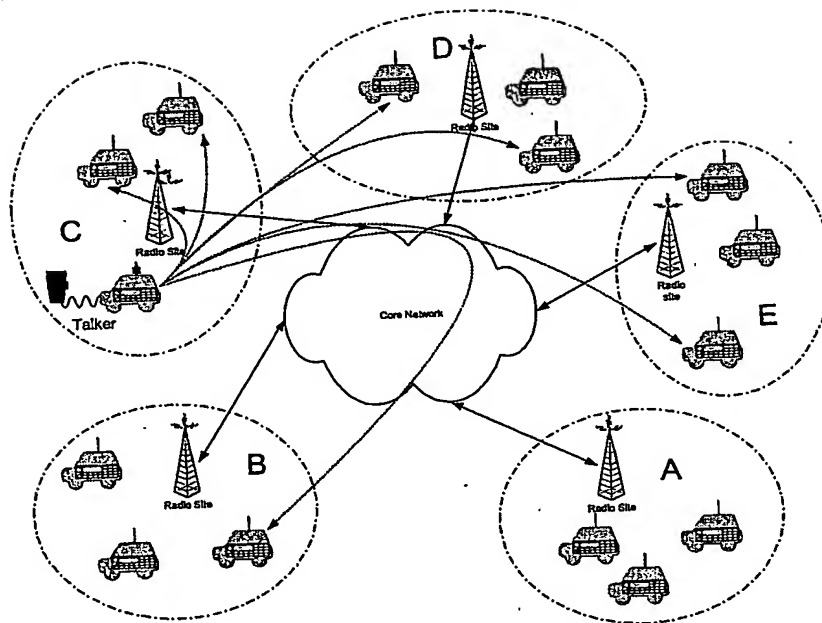
10 When traffic channels receive packets from multiple sources they will use the most recently received quality metric from each source to decide which one to transmit on the air interface. Only the packets from the source with the best quality indicator will be sent. Traffic channels which are sending data to the multicast will stop transmitting if they receive a packet with a better quality indicator than they are currently receiving on the air interface.

### 15 *Over Procedures*

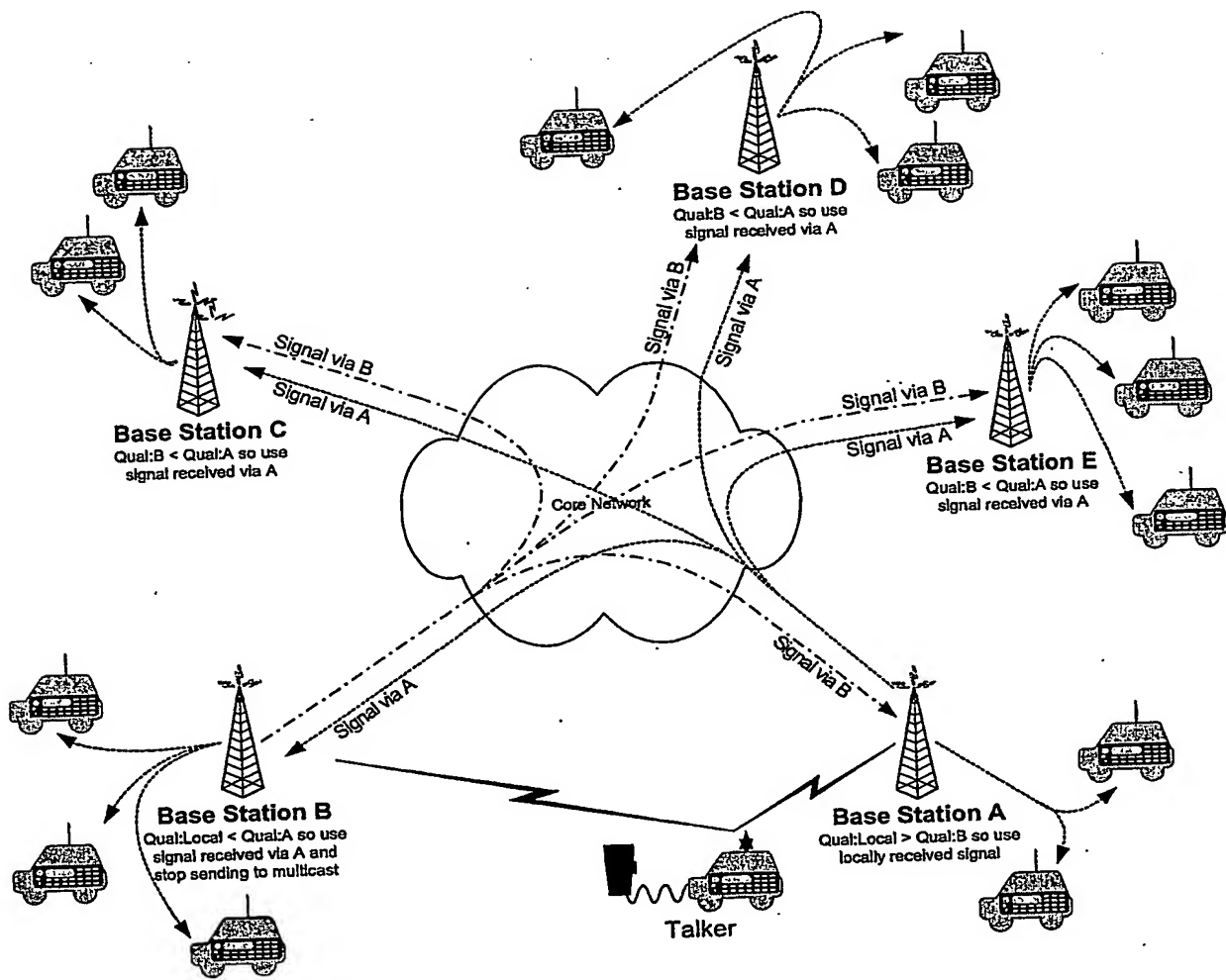
At the start of each over (a talk burst during conversation) all the traffic channels that are receiving data on the air interface will send packets to the multicast address. Only the traffic channel with the best quality signal received on it's air interface will continue sending to the multicast. The others will stop transmitting as they receive packets with better quality indicators. The traffic channel sending to the multicast will periodically send a quality indicator. This is an opportunity for other traffic channels to become the talker if they have a better signal.

At the end of each over (when the current talker stops talking and releases PTT) the base station currently sending to the multicast will send an end of over indication.

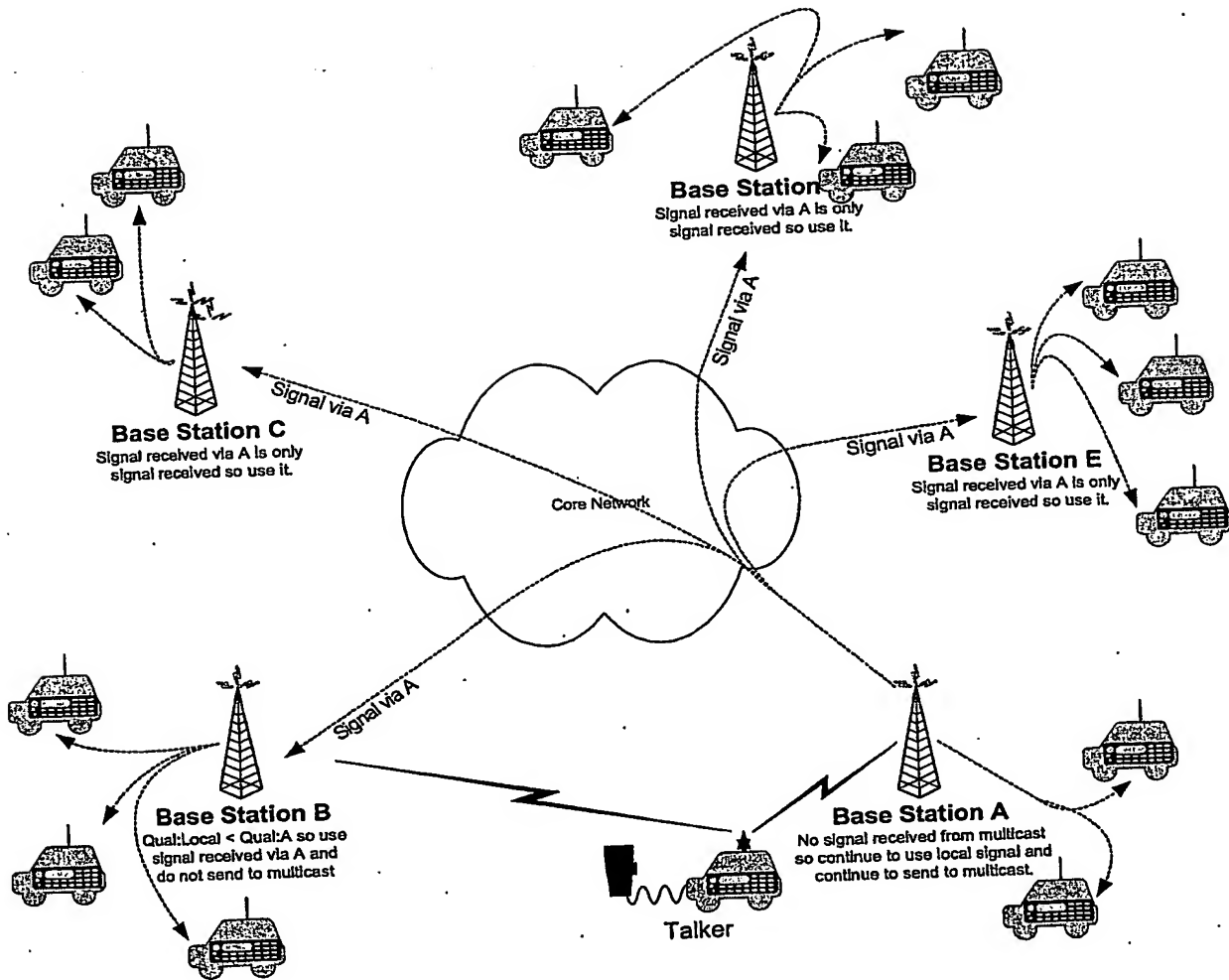
25 This indication may simply be a quality metric indicating the lowest possible quality.



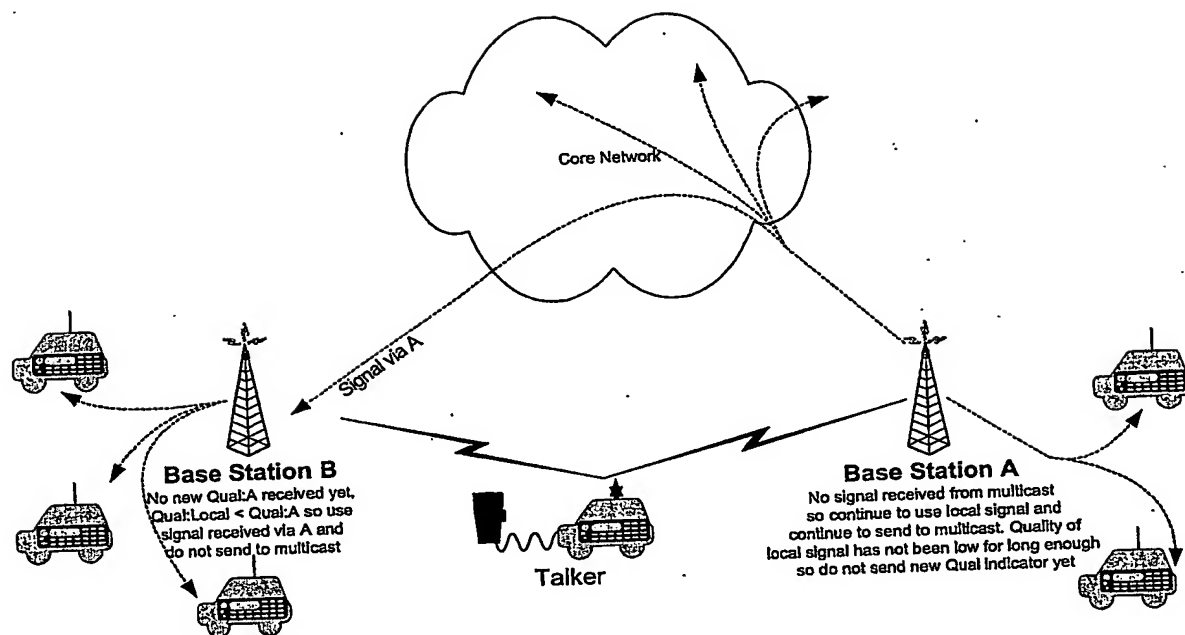
**FIGURE 1**



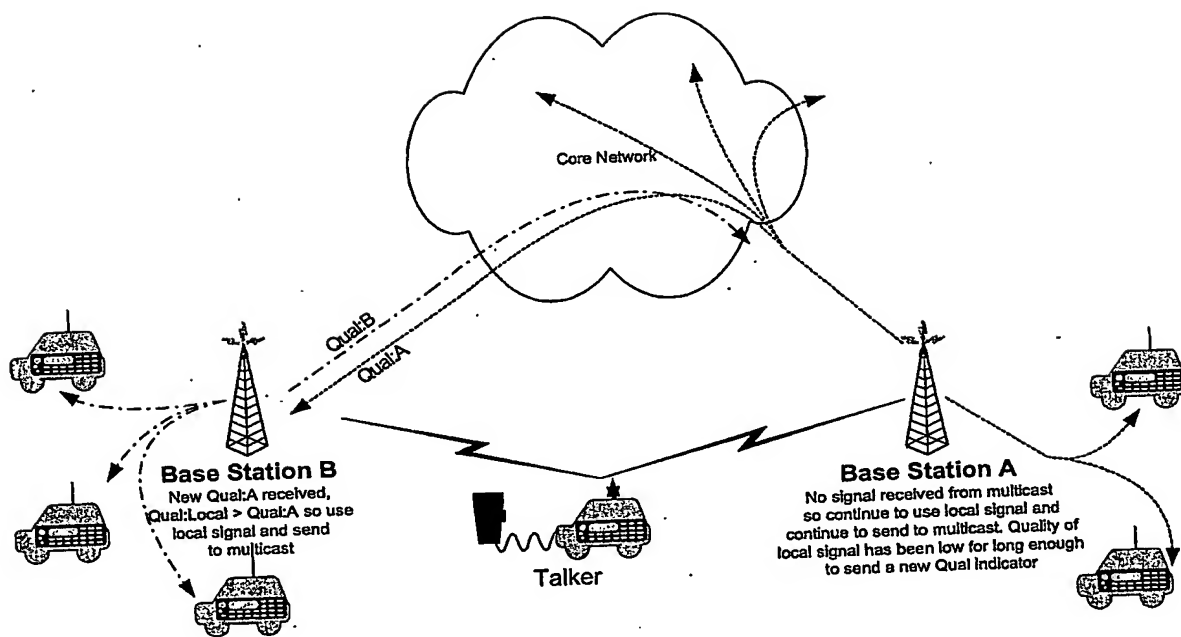
**FIGURE 2**



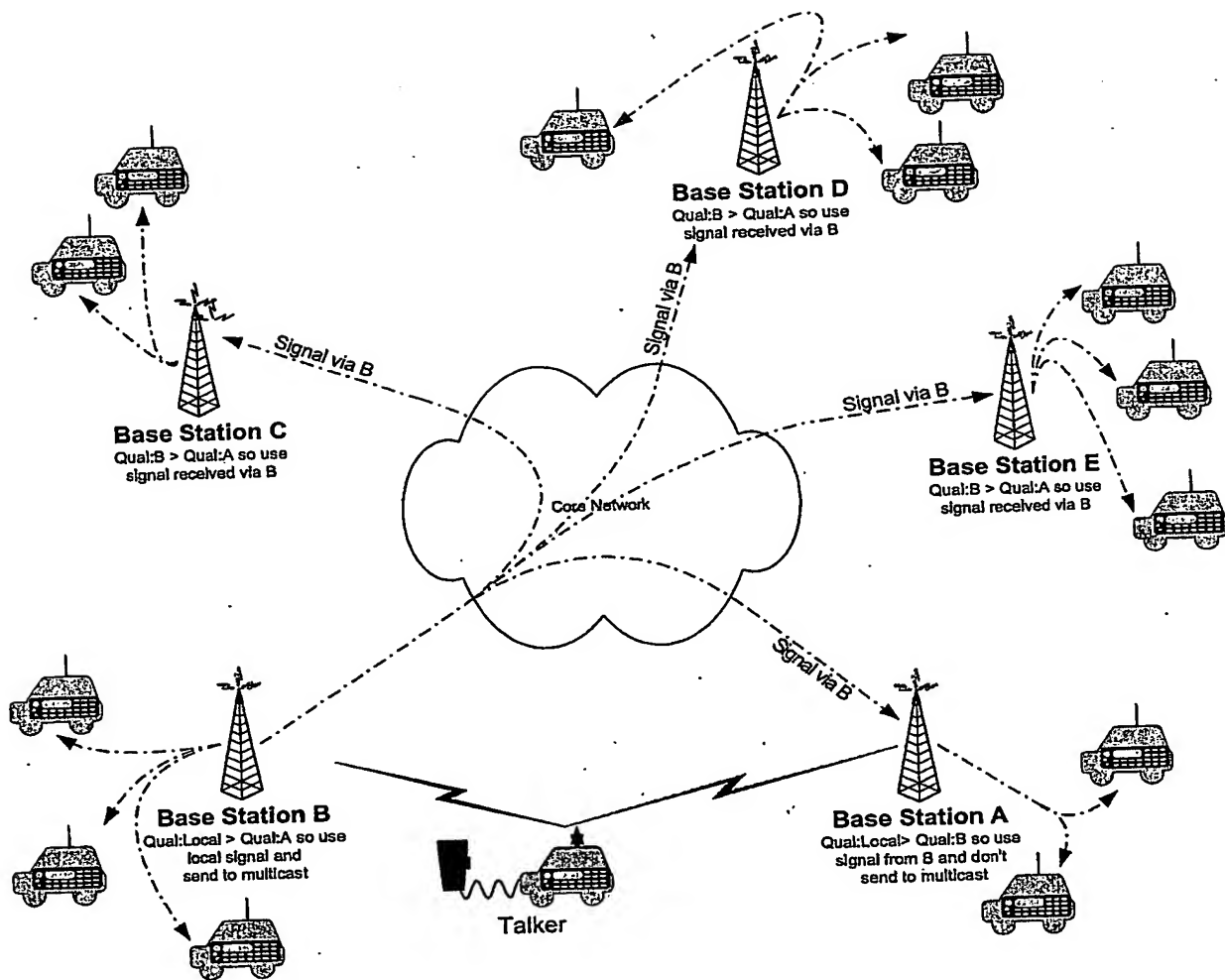
**FIGURE 3**



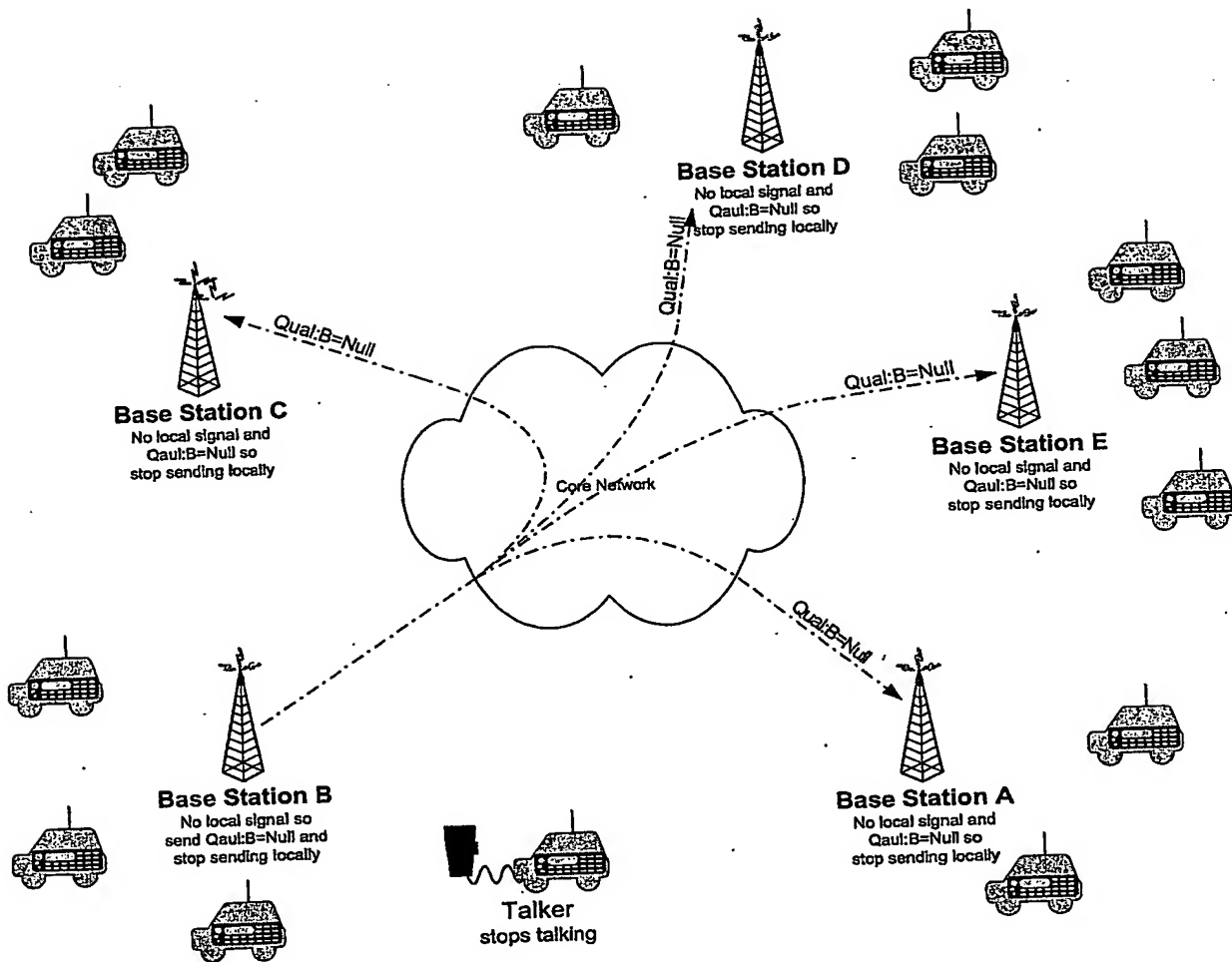
**FIGURE 4**



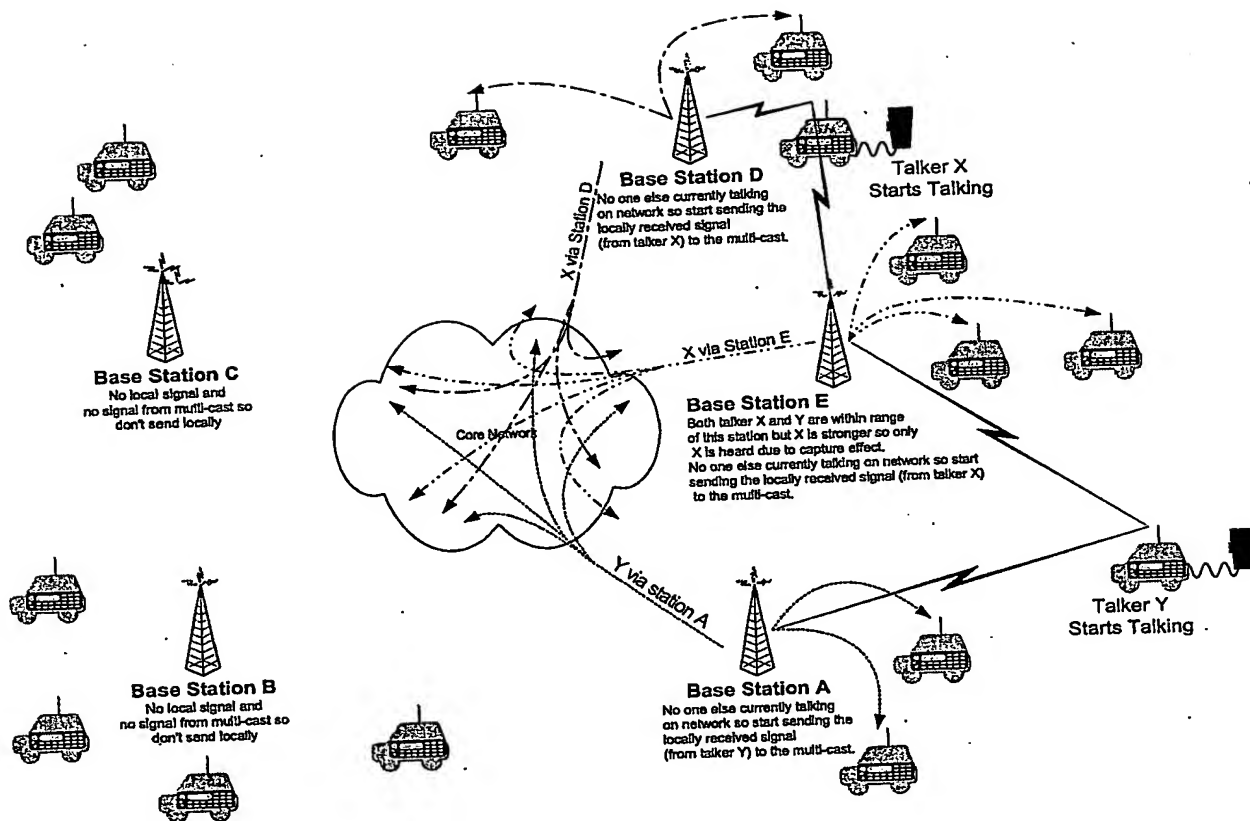
**FIGURE 5**



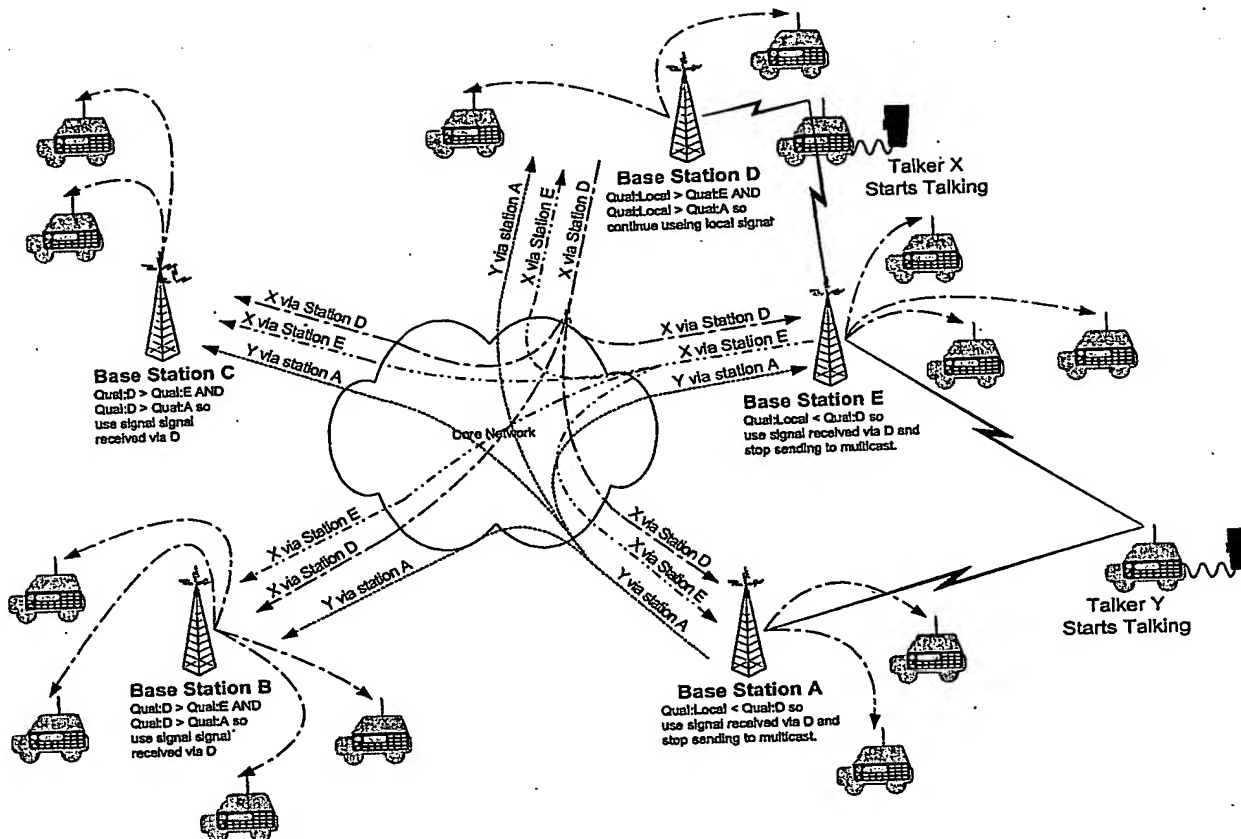
**FIGURE 6**



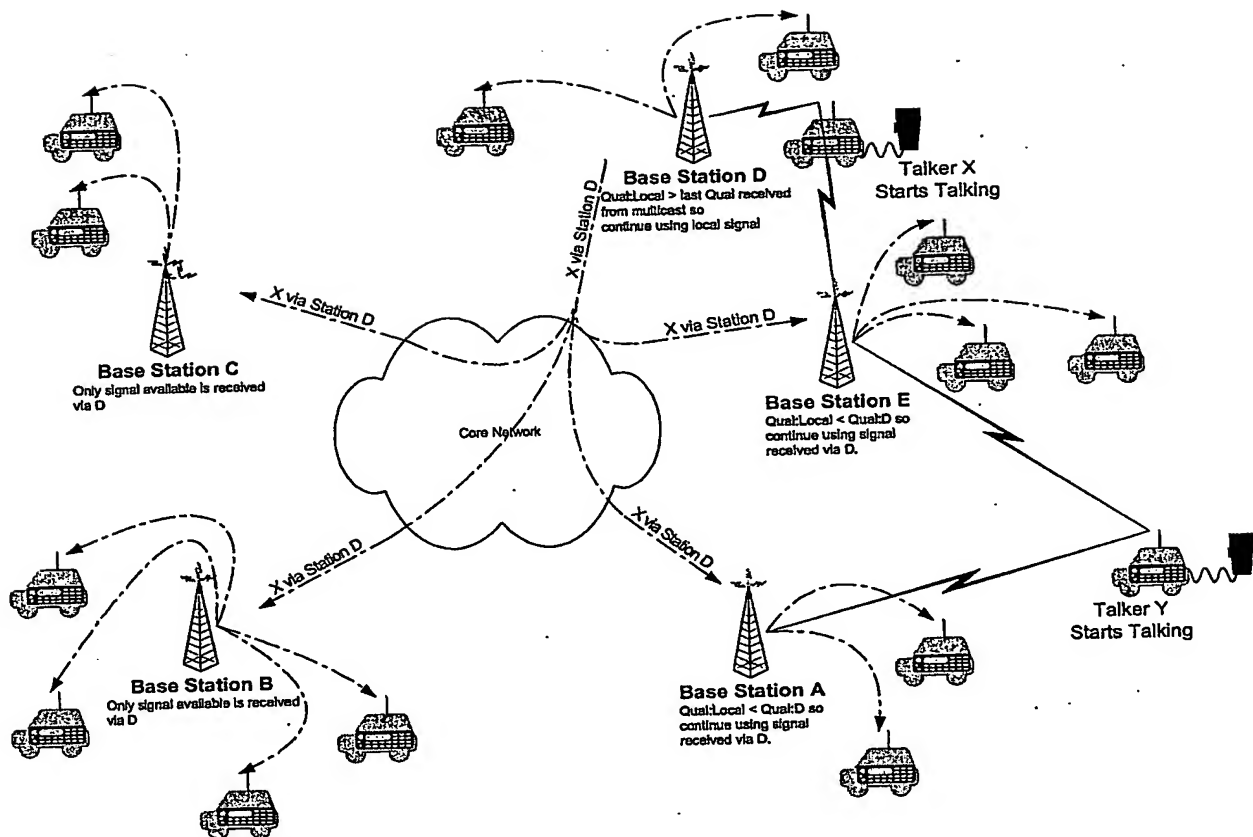
**FIGURE 7**



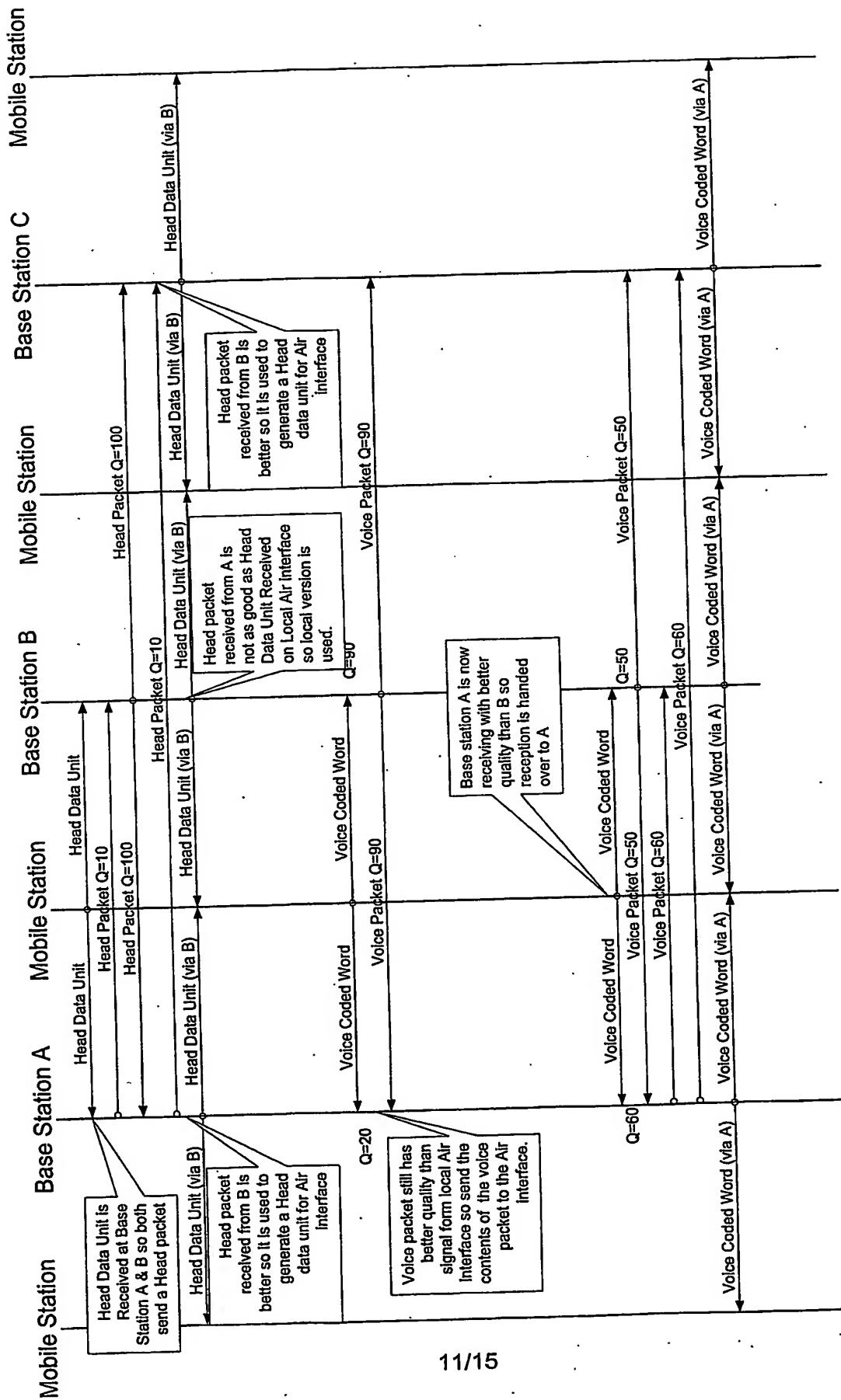
**FIGURE 8**



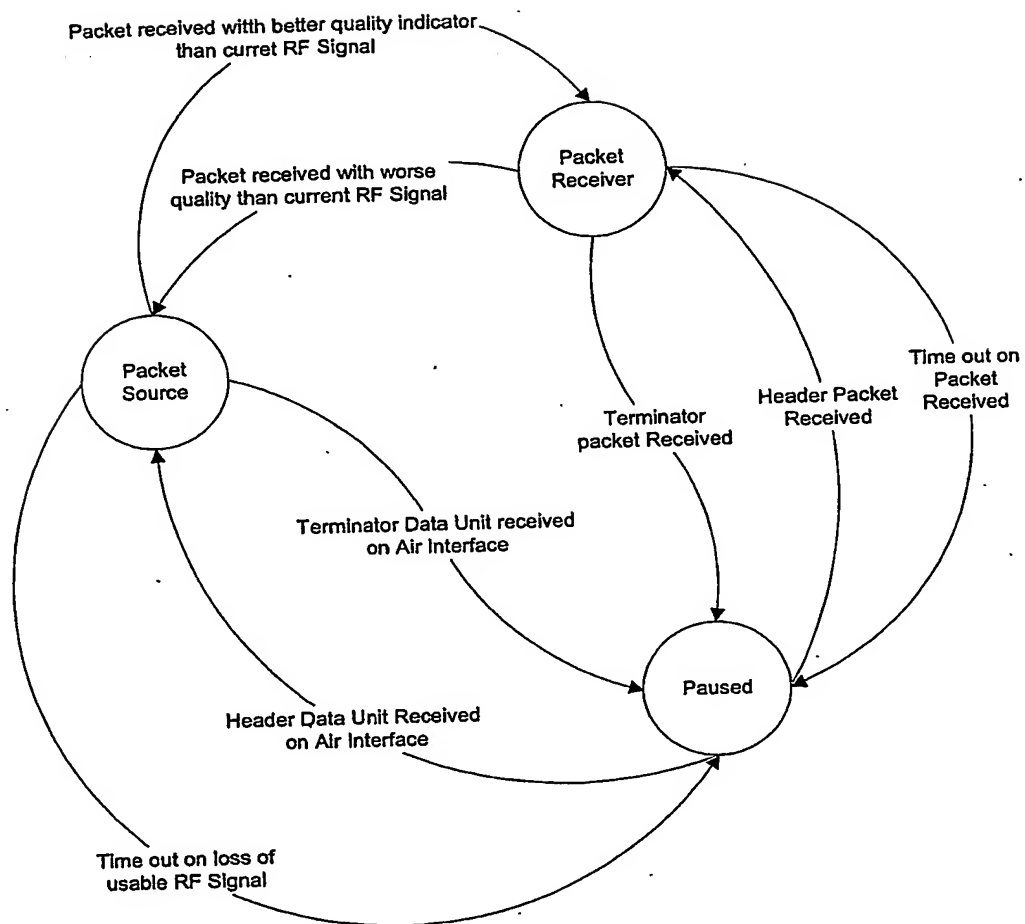
**FIGURE 9**



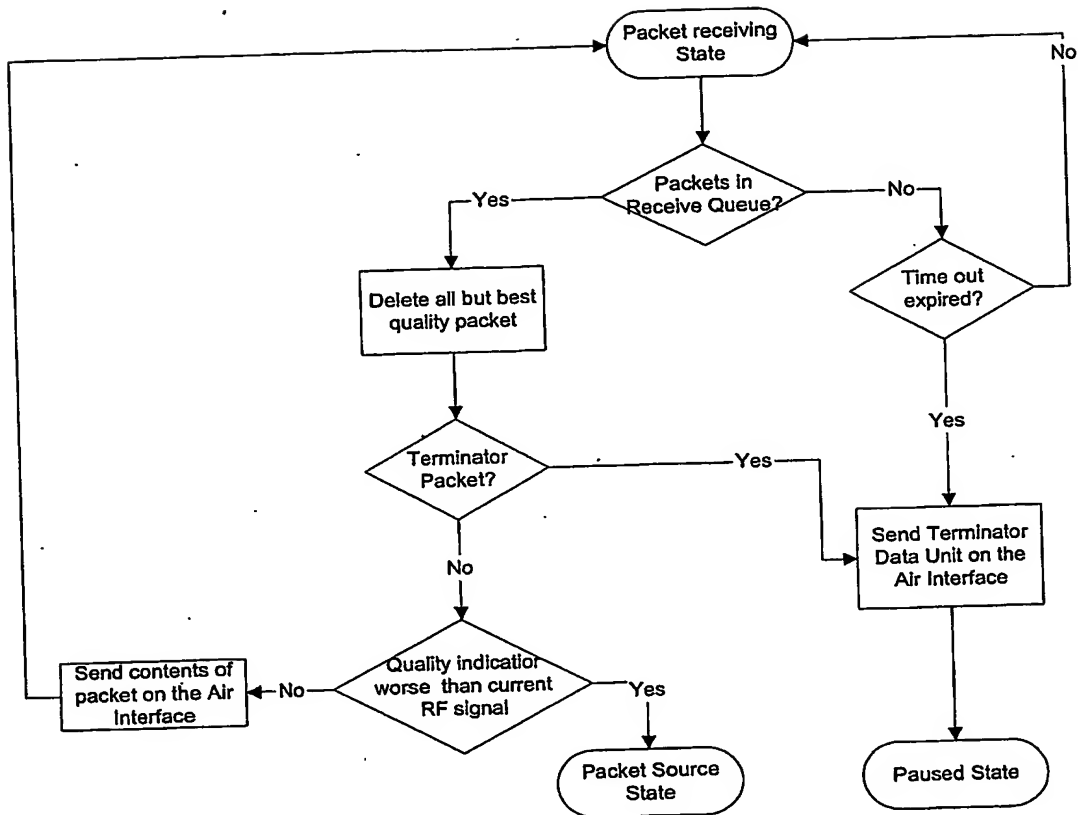
**FIGURE 10**



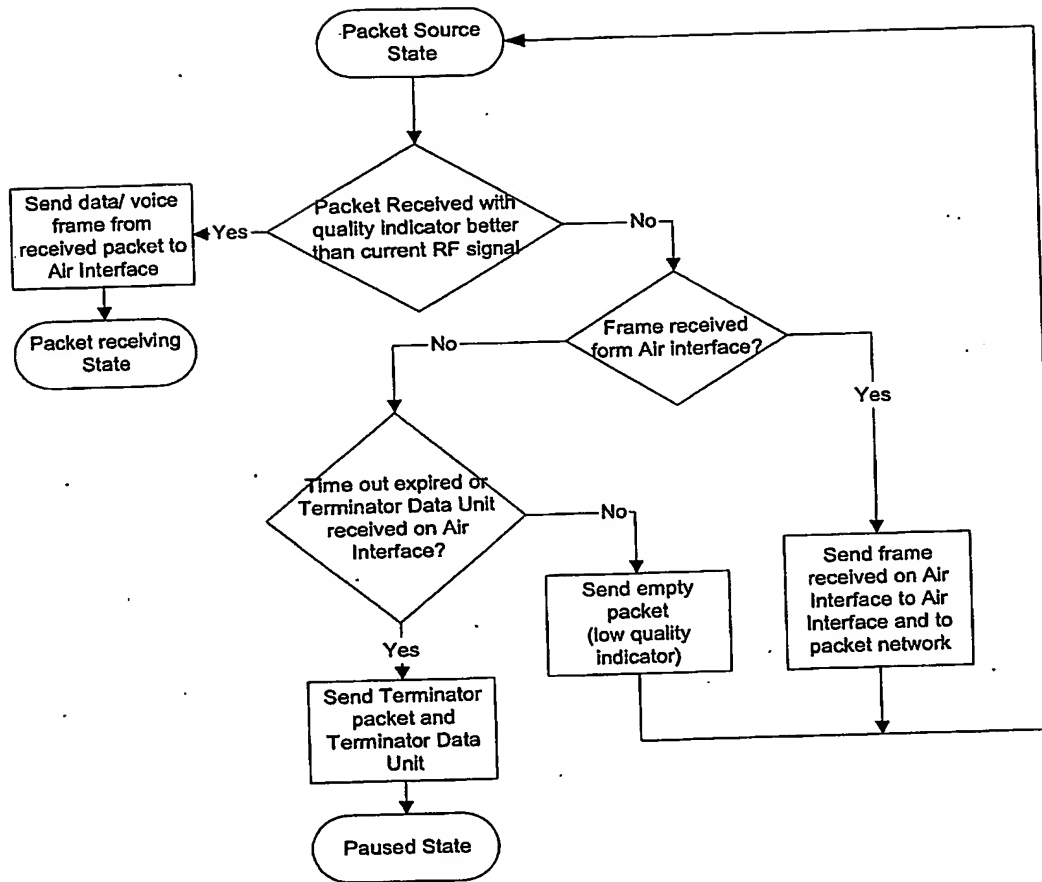
**FIGURE 11**



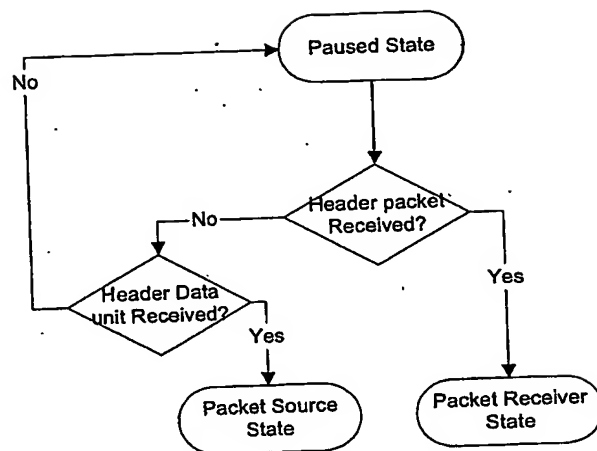
**FIGURE 12**



**FIGURE 13**



**FIGURE 14**

**FIGURE 15**

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